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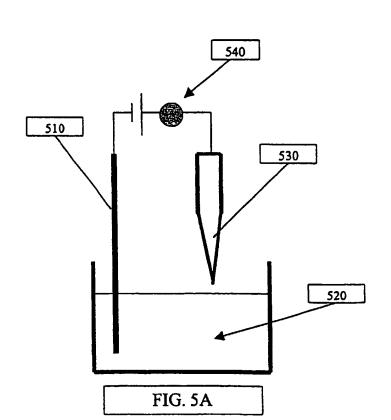
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[Continued on next page]

(54) Title: DEPOSITION METHOD FOR NANOSTRUCTURE MATERIALS



(57) Abstract: A method for depositing a coating of a nanostructure material onto a substrate includes: 1) forming a solution or suspension (520) of containing the nanostructure material; 2) selectively adding "charger" to the solution (520); 3) immersing electrodes (510, 530) in the solution (520), the substrate upon which the nanostructure material is to be deposited acting as one of the electrodes; 4) applying a direct and/or alternating current electrical field between the two electrodes (510, 530) for a certain period of time thereby causing the nanostructure materials in the solution (520) to migrate toward and attach themselves to the substrate electrode (530); and 5) subsequently optional processing of the coated substrate.



European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for the following designations AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW, ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)
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C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category * Citation of document, with indication, where	appropriate, of the relevant passages	Relevant to claim No.
X AFFOUNE et al. "Electrophoretic Deposition of N	Vanosized Diamond Particles", Langmuir	1-8, 12, 13, 16, 18 and
2001, 17, pp. 547-551.		22-24
Y	•	
		9-11, 14, 15, 17, 19-
		21, 25-73
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X US 6,258,237 A (GAL-OR et al.0 10 July 2001, a	see Examples and col. 10, lines 61-62.	1-8, 12, 13, 16, 22, 24,
·	•	28 and 29
Y		
		15, 19-21 and 25-27
Y US 5,296,117 A (DE JAEGER et al.) 22 March 1	US 5,296,117 A (DE JAEGER et al.) 22 March 1994, paragraph crossing cols. 10 and 11. 25-27	
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